UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 10.

[In order to render the results of investigations and experiments conducted by the Agricultural Department of the University of California more quickly and more generally available than has heretofore been done through the annual or biennial reports, it is proposed to embody hereafter, in the form of "Bulletins," to be issued as often as may seem desirable, reports of results, as well as such other discussions, information or answers to questions as may be of general interest. It is intended to make these bulletins, as a rule, short enough for insertion in the daily or weekly papers of the State, and proof-slips of the same will be regularly mailed to papers applying therefor. The substance of these bulletins will ultimately be embodied in a more complete and connected form, in the annual reports of the College of Agriculture.]

Examination of Soils.

Soils from the Woodside Ridge, San Mateo Co.

A set of soils from this neighborhood was furnished by Mr. E. H. Rixford, of San Francisco. They represent the ridge or series of hills, between which and the coast range lies the valley containing the hamlets of Woodside and Searsville, as well as the reservoirs of the Spring Valley Water Works. The elevation of the ridge above the sea is 450 feet; its surface is dotted with a variety of oaks, and there is an undergrowth of poison oak and "oak chapparal" (*Baccharis*) with alfilerilla and grass. The soil is of a somewhat tawny tint, sometimes inclined to be heavy, but with a considerable admixture of fine sand. The reddish-yellow subsoil is quite stiffish, and is evidently derived from the soft, clayey sandstone, that with serpentine, forms most of the lower ridges of the peninsula of San Francisco. The lighter soil is often 15 to 18 inches deep on the slopes, but the stiff subsoil often lies nearer the surface, so that the actually arable soils vary between the two extremes. Mr. Rixford states that the soil is usually best where the blue rock or serpentine is near the surface. Experience has shown that on the uplands these soils will not bear many crops without some fertilization; and the information desired, is as to the fertilizer most likely to be effectual.

Of the samples sent, the following two were analyzed in full:

No. 761. Soil from the ridge on Mr. Rixford's place; said by him to be a fair average sample of the land, taken to the depth of fifteen inches. Quite friable even when dry.

No. 757. Subsoil from the Canyada road in front of the property; appears to be about an average subsoil of the region. Color, yellow to reddish; lumps when dry, hard and not easily crushed with the finger.

	Soil. No. 761.		Subsoil. No. 757.	
Insoluble matter	82.185	89.416	50.407	72.849
Soluble silica	7.231		22.442	
Potash		.304		.439
Soda		.171		.457
Lime		.198		.711
Magnesia		.365		.955
Br. ox. of manganese		.105		.055
Peroxide of iron		2.383		7.318
Alumina		4.170		12.412
Phosphoric acid		.019		.014
Sulphuric acid		.027		.009
Water and organic matter		3.182		4.182
		100.340		99.402
Humus		.630		.248
Available inorganic		.445		.204
Hygroscopic moisture		3.004		11.485
Absorbed at		9.5 °(C.)		9.5 °(C.)

These analyses show a very marked difference between the lighter surface soil and the clayey subsoil. The latter, though rather heavy in working, would form a good soil in all but one respect, viz.: that it is extremely deficient in phosphoric acid; but it contains good proportions of lime and potash, and where humus is added by its lying near the surface, should be thrifty whenever the phosphates are supplied. The surface soil is almost equally deficient in phosphates, but has the disability of a relatively small amount of lime. Liming will, therefore, benefit chiefly the lighter soils of the region, while phosphates—say bone meal—are needed by both, about equally, and urgently.

Presidio Soils, San Francisco—The same characteristic of extremely low phosphoric acid percentages is shown in the analyses of soils from the Presidio of San Francisco, of which a set was furnished by Major W. A. Jones, of the Engineer Corps. These soils show a larger supply of potash and lime, but no better average percentage of phosphoric acid, even in the low ground. This seems, therefore, to be the besetting defect of the upland soils of the San Francisco peninsula, so far as they are derived from the sandstone and serpentine formation; and the knowledge of this fact should lead to a more frequent use of

the bone fertilizers manufactured in the city, but which now are mainly shipped across the Pacific to the islands and to Australia.

It should be added that at least from Menlo Park southward there is a sensible improvement, and in the Santa Cruz range, as well as at Pescadero, the natural supply of phosphates is quite satisfactory.

Subsoil from an unproductive spot in the Orchard of Mr. R. G. Dean, Brentwood, Contra Costa Co.—Regarding this spot, which seems to represent a number of similar cases in that region, Mr. Dean writes:

"Trees or vines live, but will not flourish in it. A row of Monterey cypress along the fence has the appearance of a young pinery scorched with flame. Fruit trees dwarf and grow feebly as they near this fatal spot. Grain, alfilerilla and foxtail grow luxuriantly, but the principal growth when under cultivation is the weed sent herewith, the roots of which penetrate several feet, and no amount of plowing or disturbance will eradicate it."

This weed was not recognized with certainty. The surface soil is a mouse-colored, fairly retentive loam; and, as from its character and the report of its production of grasses there is no doubt of its productiveness, it was not analyzed. The subsoil was taken from the depth of about eight to eighteen inches. It is much lighter colored and much sandier than the surface soil, showing a material change downwards. The analysis of this subsoil gave the following result:

Insoluble matter	71.499	76.945
Soluble silica	5.447	
Potash		.726
Soda		.253
Lime		1.085
Magnesia		1.747
Br. oxide of manganese		.303
Peroxide of iron		7.218
Alumina		7.734
Phosphoric acid		.032
Sulphuric acid		.049
Water and organic matter		4.280
		100.372
Humus		.737
Available inorganic		.778
Hygroscopic moisture		8.999
Absorbed at		11°(C.)

This subsoil shows one deficiency, viz., in the supply of phosphoric acid. In all other respects the material would count as a good and even generous soil. The surface soil is doubtless much richer in phosphoric acid, and the deeper portions of the subsoil much poorer, so that the deep-rooted plants and trees, being in summer deprived of the use of the surface soil by the drought, cannot obtain a proper supply of the needful plant food. But besides this, the condition of the subsoil points to a lack of proper drainage.

The obvious remedy would be to work in as deeply as possible, and in advance of the winter rains, a good dose of bone meal, or preferably superphosphate. The water would then gradually carry the needed supply of phosphates down within reach of the deeper roots, so as to give them sustenance in summer.

Granite Soil from near Pino Station, C. P. R. R., Placer county, sent by Mr. E. W. Maslin, of Sacramento, who thus describes the general character of the country.

"There are about 80 square miles of such land lying between Boulder ridge and the North Fork of the American river, and between Roseville and the south and Auburn ravine on the north. The ground is grey when dry; when damp, brown or reddish. In places the soil is 9 to 10 ft deep; in some places not over one foot. The subsoil also varies in depth and character. On the hills the subsoil rests on a red, rotten granite, into which the roots of trees and shrubs penetrate. It has been dug with the pick to the depth of 20 ft. In the valleys there underlies a gritty clay, here called 'cement,' but also penetrable by roots. Water is within 10 to 12 ft of the surface on the hills in summer. The natural growth is live oak, white oak, Digger and nut pine, chaparral 8 to 10 ft high, abundance of poison oak, and 'California holly' (red haw, *Photinia*)."

Specimens of vine canes, the growth of one season, accompanying the soil samples, showed a very good length, although planted late in the dry season of 1881–2, and never irrigated.

Of the samples sent it seemed most desirable to examine the hill soil, which seems to be the typical one, from which the rest are derived and vary more or less. It is a reddish-grey, sandy loam, the sand mostly coarse and consisting largely of granitic debris; it should till easily at all times. The subsoil, below the depth of twelve inches, is somewhat lighter colored and more sandy. The soils from the depressions or valleys seem to differ from the hill land mainly in being somewhat heavier and also of a darker tint.

The analysis of the hill soil gave the following result:

Insoluble matter	78.942	85.225
Soluble silica	6.283	
Potash		.653
Soda		.298
Lime		.758
Magnesia		1.280
Br. oxide of manganese		.087
Peroxide of iron		2.301
Alumina		6.816
Phosphoric acid		.031
Sulphuric acid		.018
Water and organic matter		2.598
		100.065
Humus		.514
Available inorganic		.332
Hygroscopic moisture		2.142
Absorbed at		10°(C.)

This analysis shows the soil to contain good percentages of mineral plant food, except phosphoric acid, of which the supply is quite small and would not hold out long under the cultivation of cereal crops. Compared with the red

soil around Auburn (see report for 1879, page 21), this soil contains only one-fifth as much phosphoric acid, somewhat less lime, but nearly twice the amount of potash; a circumstance that, with the comparatively small supply of humus, low retentiveness, but usually considerable depth and a substratum of "rotten" granite, points to its adaptation to the production of grapes, of which quality rather than quantity would form the chief recommendation. The fig and olive, and probably the cherry, would also do well on the hill soil, while in the valleys, where both phosphates and humus are doubtless more abundant and the soil is more retentive, other fruits would thrive; but wherever the growth languishes the use of bone meal should be very effective.

Except as to inferior retentiveness and humus supply, this soil is very similar in composition to that of Vaca valley, on which cherries flourish so well. Details regarding the latter will be given in a future "bulletin;" but it is important to note the frequent deficiency in phosphates that characterizes the soils of many regions in the State, and the importance of an adequate supply of phosphatic fertilizers to the continued prosperity of such districts.

E. W. HILGARD.

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